

METHOD AND SYSTEM FOR NAVIGATING AN AGRICULTURAL VEHICLE ON A LAND AREA

FIELD OF THE INVENTION

[0001] The invention relates to the field of navigating vehicles, and more specifically to a method and system for navigating agricultural vehicles on a land area.

BACKGROUND OF THE INVENTION

[0002] In agriculture, when working large areas of land, different vehicles are used, such as tractors and towed farm vehicles such as plows, rippers, disks, planters, applicators, drills and other equipment. A control of the track of such vehicles, i.e. navigating the vehicles, is more and more automated to reduce or avoid intervention by human operators. GPS technology and systems based on a similar global navigational satellite system, GNSS, support self-propelled vehicles in accurately following predetermined tracks, even in dusty and dark conditions. Such tracks have been predetermined, and their position coordinates are compared with actual GNSS position coordinates in order to control a path of a vehicle equipped with a GNSS receiver to adhere to the predetermined track.

[0003] A GNSS allows operations on a land area to be performed more accurately and efficiently, using less fuel, less herbicides and other chemicals, and less time, while improving the quality of the soil and the products grown.

[0004] A disadvantage of using GNSS technology is that in adverse circumstances the satellite signals on which the positioning relies can be disturbed to an extent that the required positioning information is unavailable, or cannot be used. Another disadvantage of use of a GNSS for navigating is that the positioning information provides a limited position accuracy. A further disadvantage of use of a GNSS is that the algorithms used to process the positioning signals tend to change often, so that frequent updates are necessary.

[0005] A still further disadvantage is that GNSSs only allow a vehicle to follow a predetermined track on a land area, not taking into account the actual circumstances on the land area, such as a nature-induced or a man-induced obstacle, in particular when the vehicle is unmanned. A nature-induced obstacle can for example be a local flooding. A man-induced obstacle can for example be a rock pile. Such obstacles in fact would make it necessary to avoid the obstructed area for several reasons. First, the intended working of the land in the obstructed area would in many cases not have the desired effect at all. Second, there is a great risk of the vehicle getting stuck or being damaged or otherwise rendered unusable when entering the obstructed area.

[0006] Accordingly, a need exists for an improved method and system for navigating agricultural vehicles on a land area, whereby at least one of the identified disadvantages is reduced or overcome.

SUMMARY OF THE INVENTION

[0007] It would be desirable to provide a method and system for navigating agricultural vehicles on a land area that does not, or does not substantially, rely on GNSS technology. It would also be desirable to provide a method and system for navigating agricultural vehicles on a land

area that allows for adaptation of a track to differ from a predetermined track in case actual circumstances would necessitate such adaptation.

[0008] To better address one or more of these concerns, in a first aspect of the invention a method of navigating an agricultural vehicle on a land area is provided according to claim 1, in particular the method comprising:

[0009] building a map of the land area, with the help of an aircraft with a camera system and based on a plurality of landmarks in the land area;

[0010] imaging, in real-time, at least part of the land area from above to provide a sequence of images showing the vehicle and at least one landmark;

[0011] identifying positions of the vehicle on the land area from the sequence of images by image processing, to provide vehicle data based on the identification of the positions of the vehicle;

[0012] identifying a position of at least one landmark on the land area from the sequence of images by image processing, to provide landmark data based on the identification of the position of the at least one landmark;

[0013] controlling a path of the vehicle across the land area based on the built map, the vehicle data and the landmark data.

[0014] The method of the invention does not rely on the use of a GNSS, or at least does not rely primarily on the use of a GNSS, and thus may avoid at least some of the disadvantages of such system as explained above. Nevertheless, the method of the invention can be combined with a GNSS if it would be desirable to work the land area in circumstances when imaging the land area does not, or does not sufficiently, provide information, such as at night or under low visibility conditions, e.g. misty or cloudy conditions.

[0015] The building of a map allows a better, more precise knowledge of the land area, which may lead to easier, better or more complete land usage. For example, knowing exactly where the land area ends, or where a stream or ditch is, will provide knowledge to guide the agricultural vehicle, which knowledge will not come from gps coordinates of the corners of the land alone, since the ditch may have eroded and so on.

[0016] The real-time imaging of the land area will provide information on the actual state of the land area, including any obstacles that should be circumvented by the agricultural vehicle, and that may have a temporary and/or unexpected character such as caused by weather conditions. With information on the obstacles, the path of the vehicle can be controlled to deliberately deviate from a predetermined track to avoid the obstacle, if necessary or advisable, even without human intervention. The real-time character of the imaging ensures the control of the path of the vehicle to be in time for a continuous and uninterrupted movement of the vehicle.

[0017] Controlling the path of the vehicle comprises controlling a direction of movement of the vehicle, e.g. by controlled actuation of a steering mechanism of the vehicle while the vehicle is driven to move. Preferably, the controlling is done by an automatic controller.

[0018] Note that it is not strictly necessary for the airborne vehicle, or aircraft, to be present at the same time as the agricultural vehicle whose path is to be controlled. Rather, it is also possible to let the aircraft build the map, including positions of landmarks, while the step of imaging to provide